Factors Associated with Pesticide Use among Vegetable Farmers in Negros Oriental, Philippines

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Averse to pest-related risks, farmers commonly resort to pesticides despite the existence of alternative strategies to crop pest management. The study sought to determine factors related to vegetable farmers' decisions to use pesticides as a primary pest control strategy. Face to face interviews with 151 commercially-oriented vegetable farmers from four vegetable growing municipalities in the province of Negros Oriental was conducted to gather data needed for the study. Results show that the vast majority (88%) of the surveyed farmers employed pesticides as a main pest control strategy. Socio-economic factors such as gender, number of land parcels cultivated, and level of household income of the surveyed farmers were significantly related to the farmers' decision to use pesticides for pest control. Farmers' assessment of the extent of pest and disease infestation on their vegetable crops and their perceived effects of pests on crop yield were significant determinants of pesticide use. Other factors influencing farmers' decision to use pesticides were their regard of pests as severely destructive, the perceived increase in pest populations, and their desire to prevent, control, or eradicate pests to ensure better crop yield. Information sources, the frequency of contact with pesticide dealers, and membership in farmers' organizations significantly influenced farmers' decision to use pesticides. The study recommends that appropriate government agencies sustain, expand, and be more aggressive in promoting Integrated Pest Management (IPM) practices among vegetable farmers.

Keywords: Vegetable Pests, Pesticides, Pest control

INTRODUCTION

Despite the existence of alternative strategies to pest management, Rola and others (1999) reported that the vegetable farmers' crop protection strategies in many parts of the country are mostly chemical-based. Averse to pest-related risks, farmers commonly resort to pesticides, a class of chemical substances that are applied directly to the soil or sprayed on crops to control destructive organisms such as insects, fungi, molds, nematodes, and rodents (Rodriguez et al., 2011). Unfortunately, these substances have pronounced persistence against chemical/biological degradation, high environmental mobility, a strong tendency for bioaccumulation in the tissues of humans and animals, and have a significant impact on human health and the environment, even at deficient concentrations (Liu et al., 2009). In many instances, the use of pesticides caused adverse effects on human health (Lu, 2009), particularly to those directly or indirectly exposed to its use, or those that consume agricultural products contaminated with its residues (DPR, 2008). Furthermore, there are other equally alarming negative externalities resulting from the misuse of pesticides, such as "environmental damage to the soil, surface water, groundwater, and air quality" (Lu, 2011).

Farming decisions are influenced by a range of factors, including socio-demographics and psychological make-up of the farmer, the characteristics of the farm household, the structure of the farm business, the broader social milieu, and the features of the innovation to be adopted (Edwards-Jones, 2006). In a study on the socio-economic parameters of pesticide use and assessment of the impact of an Integrated Pest Management (IPM) strategy for the control of specific eggplant insect pests, Baral and others (2006) pointed out that the farmers' awareness about IPM, availability of IPM inputs, perceived economic and health benefits, and degree of pest damage promoted the adoption of IPM. On the other hand, the size of landholding, the age of decision-makers, and easy access to pesticides hindered the adoption of IPM, leading to pesticides as the primary pest control measure.

Baconguis (2002) pointed out that many studies cited conflicting findings on the relationship between farmers' choice or adoption of technology and such factors as age, educational attainment, farming experience, and extension visits. Hence, to validate their relationship to the farmer's choice and adopt a pest management strategy, these factors are included in this study.

This study is underpinned by the diffusion-adoption theory and the human-environment interaction theoretical perspective. Adoption theory posits that socio-economic, cultural, psychological, biophysical, and extension-related factors affect the farmers' decision to adopt technological innovations (Rogers et al., 1998). On the other hand, the non-equilibrium paradigm posits that ecological systems are open and affected by internal and external factors, lack a stable point of equilibrium, non-deterministic, and affected by human influences (Botkin & Soble, 1995 in Pickett et al., 1994 as cited by Baconguis, 2002). In this context, the study examined the different factors that led to farmers' decision or choice of a pest management strategy. The study sought to determine the influence of specific demographic, socio-economic, psychological, and extension-related factors on farmers' decision to adopt pesticides as a primary pest control strategy.

METHODOLOGY

This descriptive study employed survey methods. Data were collected from farmers through face to face interviews by trained field enumerators using a pre-tested structured interview schedule. The study sites included four of the major vegetable growing areas in the province of Negros Oriental, namely: the municipalities of Valencia, Bacong, Sibulan, and the City of Canlaon.

The study employed purposive quota sampling to select vegetable farmers included in the study using a minimum quota sample of at least 60 vegetable farmers for each group of the vegetable area. The neighboring municipalities of Valencia, Bacong, and Sibulan, located in the vicinity of Dumaguete City, were treated as a group. Valencia is within the geographic confines of 9° 16' 00" to 9° 20' 00" N latitude and 123°04'00" to 123°12'00" E latitude, while Bacong is located at latitude 9°14'50.2" N longitude and 123 o 17'37.3" E. The municipality of Sibulan is situated at approximately 9° 22' North, 123° 17' East. On the other hand, Canlaon, situated at approximately 10° 23' North, 123° 13' East, more than 160 km north of Dumaguete, was considered another group.

The inclusion criteria used in selecting farmers in the survey were the following:

a) Farmers who lived in the same barangay as their vegetable farms for at least one year before the start of data collection;
b) Farmers who commercially grew Cabbage, Chinese Pechaye

(Chinese cabbage), Broccoli, Cauliflower, Eggplant, and Ampalaya, singly, or in combinations, during the conduct of the study and for at least one year before the start of the study; and

c) The size of field plots for each vegetable type must not be less than 100 square meters in size.

The choice of the crops for inclusion in the study include considerations of their economic importance and popularity in the local market and reports of heavy pesticide usage by farmers. A total of 151 farmers agreed to participate in the study upon meeting the inclusion criteria selecting farmer respondents. Data were encoded and analyzed using the SPSS program. The data were summarized using descriptive statistics, while the Chi-Square test of independence was employed to establish relationships between variables.

RESULTS AND DISCUSSION

Profile of Respondents

The majority (58.3%) of the surveyed farmers were males, married (90.1%), Catholics (90.6%), and on average had 3.47 children, with a mean household size of 4.64. They were relatively young, averaging 44.68 years in age, with 64.2% having ages above 40. Close to 99% received a formal education, with more than half (51.6%) possessing some years of elementary education. Only two had no formal education.

The respondents were experienced farmers having engaged in this livelihood for nearly 25 years. The vegetable farming experience was shorter by about two years, with a mean of 22.62 years. Annually, farmers' gross income from their various farming activities averaged P137, 805.70, while the mean income from off-farm sources was P94, 040.

Most of the farmers owned small landholdings averaging 0.66 ha in size, about half (0.33 ha) devoted to vegetable production. Farms are parcelled into two and are situated half a kilometer away from farmers' homes. The majority (56.3%) owned the land they tilled, while nearly 30% were tenants. Areas planted to cabbage averaged 0.23 ha while Chinese pechay and broccoli farms had a mean size of 0.19 ha. On the other hand, cauliflower plots averaged 0.11 ha, eggplant 0.18 ha, and ampalaya 0.14 ha.

The majority (66.2%) self-financed their farm operations, while 17.9% augmented their capital with borrowed money. Close to 16% relied entirely on borrowed capital. Eighty-eight (58.3%) farmers utilized family members as a source of farm labor, while nearly 42% hired other farmworkers' services. The farming-related information came from pesticide dealers (57%), government agricultural technicians (56.4%), and neighbors. The majority had interactions with agricultural technicians who regularly visited their communities on farm-related matters and pesticide dealers on crop pest-related issues.

About 61% of the surveyed farmers were members of farmer's organizations and had attended farming-related training or seminars. Close to 65% were unaware of government-sponsored programs related to pest management in their localities. However, about 40% had participated in IPM/ Farmers Field School (FFS) program in the past. More than half of the surveyed farmers did not follow IPM practices on their farms. Nearly 80% knew of no policies at the local level regarding pesticides in farms and expressed the need for such.

Socio-economic Factors and Pesticide Use

Previous studies have shown that farmers' socio-economic and demographic characteristics influence their decision whether to adopt or reject a technology (Akinola et al., 2007). The study showed that there was a relationship between the genders of the farmers with the decision to utilize pesticides as the primary pest control strategy (Table 1). Previous studies by Davidson and Freudenburg (1996), Dosman et al. (2001), Franzen and Meyer (2010), and Hanson (2007) demonstrated that gender influenced the perception of pesticide use. By proportion, more men tend to lean towards pesticide use than women. Male farmers make decisions for the farm because male farmers tend to spend more time on the field than women. Male farmers are likely to encounter actual pest problems in the field, and these spur them to decide to use pesticides as a pest control strategy. However, previous studies showed that female farmers are warier of the harmful effects of pesticides on the environment compared to males (Franzen & Meyer, 2010, as cited by Ahmed et al., 2011), thus explaining why more males favored the use of pesticides than females.

On another note, the age of the respondents was not significantly related to their pesticide use decisions, which means that regardless of their

age, the respondents tend to favor pesticide use. This finding is inconsistent with the results of previous studies conducted by Franzen and Meyer (2010) and Hanson (2007), which showed that age, influenced the perception of pesticide use. Results of other studies determining the relationship between age and people's perceptions of pesticides gave conflicting results. For instance, according to the results of the studies of Dunlap and Beus (1992) and Tassell van et al. (1999), older persons perceived pesticides to be less harmful to the environment than younger persons. However, contradictory results by Dosman et al. (2001), showing that the older respondents were, the higher was the perception of pesticides in their food being a health risk. The absence of a significant relationship between age and pesticide use may be related to varying opinions about pesticides. In the current study, the pervasive use of pesticides among farmers regardless of age is triggered by the severity of pest occurrence and the farmers' aversion to risks of potential crop losses.

Table 1

Test of Independence between Pesticide Use and Selected Socio-Economic Factors

Socio-economic Factors	Chi-Square	df	P-value	Remarks
Gender	4.11	1	0.043	Significant
Age	2.87	1	0.09	Not significant
Educational Attainment	1.32	1	0.251	Not significant
Civil Status	0.57	2	0.751	Not significant
Number of Children	3.38	2	0.185	Not significant
Household Size	1.15	1	0.285	Not significant
Size of Vegetable Farm	2.05	1	0.153	Not significant
Land Tenure	4.67	3	0.197	Not significant
Number of Land Parcels	12.3	3	0.006	Significant
Income from Farming	2.80	1	0.094	Not significant
Household Income	11.3	2	0.004	Significant
Length of Farming Experience	0.763E-01	1	0.782	Not significant
Source of Farm Labor	2.12	1	0.145	Not Significant

There was no relationship detected between the educational attainment of respondents and their decision to use pesticides. Farmers with relatively higher levels of formal education did not vary with those that had lower levels of education regarding their pest control decisions. The majority embarked

on a decision to use pesticides regardless of their educational attainment. This finding runs counter to what Nieuwenhuijsen et al. (2005) reported that non-pesticide users were more educated people as cited by Ahmed et al., 2011), which conversely suggests that less educated people tend to favor the use of pesticides. In many studies, education is a predetermining factor in technological adoption among farmers of various socio-economic circumstances (Nasiru et al., 2006). The pervasiveness of pesticide use in the sample farming communities and the pest incidence's perceived severity may have influenced farmers' practices regarding pest management.

Results show that the farmers' civil status is not related to their decision to use pesticides for crop protection. The majority of the respondents were married, suggesting that they have family responsibilities, including producing sufficient marketable produce to support family needs. The results reveal that there were other more compelling reasons, such as the fear of yield loss and the need to ensure a good harvest for the decision to use pesticides. Similarly, the number of children and the size of the farmers' household were not influential factors in their pest management decisions. Data show that the average number of children and average household size was 3.47 and 4.64, respectively, suggesting that there is available family labor to assist in farm operations. In a study on the socio-economic parameters of pesticide use for the control of eggplant fruit and shoot borer in India by Bara et al. (2006), the farmers' landholding size was significantly related to pesticide use. However, such was not supported in this study, where farm size was not related to the adoption or use of pesticides against crop pests. Thus, regardless of the size of their farm, farmers tend to favor a chemical-based pest management strategy generally, making this observation similar to Dinpanah and Nezhadhosseini (2013) findings in a study on the determinants of farm-level pesticide use in Bangladesh by Rahman (2006), land ownership was positively related to pesticide usage, contrary to the findings of this study where there was no relationship between land tenure arrangements and pesticide usage. Pesticide usage by farmers is not dependent on whether the farmer is a landowner, a lessee, tenant, or a certificate of land transfer beneficiary.

On the other hand, the number of land parcels a farmer cultivates was significantly related to the decision to use pesticides. Most farmers cultivate more than one parcel of land, usually in different locations, with an average distance of about 500 meters between parcels. Keeping track of separate

parcels planted to vegetable crops may prove a daunting task to a farmer, considering the vegetable farming's labor-intensive nature. Farmers likely find it more manageable to deal with crop pests using pesticides.

Similarly, farmer's income was found to be related to their decision to use pesticides. A farmer whose total income from all sources tends to be higher tended to opt for pesticides and is related to the farmer's capacity to purchase this farm input. Pesticides do not come cheap. Acquiring them requires cash investments. It appears that the higher the total family income of the farmer is, the higher is his purchasing power. Hence the more likely he is going to purchase pesticides for farm use.

In their study on the socio-economic determinants of insecticide usage in cowpea production in Nigeria, Adeola et al. (2011) found a direct relationship between the years of farmers' experience and level of insecticide use. However, such was not the case in this study. There was no relationship detected between the length of farming experience and pesticide use. Regardless of the number of years in vegetable farming, most of the farmers adopted the use of pesticides in controlling pests. Again, the pervasiveness of the practice among vegetable growers may have pressured farmers to follow the same for fear of yield losses due to pest infestation on their crops. This finding suggests that there are factors other than the demographic characteristics that have a significant bearing on pesticide use decisions.

Agro-Ecological Factors and Pesticide Use

The test of independence between variables revealed that a significant factor in farmers' decision to use pesticides against crop pests is the extent of insect pest infestation on their vegetable crops ($p=0.000$) (Table 2). The mere presence of insect pests could inevitably result in crop damage, which adversely affects yield. The level of pest infestation is certainly a determinant of the extent of crop losses, with severe infestation resulting in severe damage and a consequent significant reduction in yield. In like manner, the extent of crop disease infestation is significantly related to farmers' use of pesticides against crop pests. These decisions are related to Asadpour's (2011) findings, which pointed out that risk aversion of farmers and the value they place on yield per hectare, among other factors, affect the choice of pest management strategies.

On the other hand, the extent of weed infestation was not associated with herbicide use. As is widely known, weeds have adverse impacts on crop performance through direct competition for soil nutrients, water, light, and space, and as potential hosts of other insect pests. Therefore, regardless of the density of the weed population in the field, farmers did not use herbicides. None of the surveyed farmers used herbicides to deal with their weed problems. All of the farmers involved in this study did manual weeding or employed cultivation practices to control and prevent the proliferation of weeds.

Table 2

Test of Independence between Pesticide Use and Selected Agro-Ecological Factors

Agro-Ecological Factors	Chi-Square	df	P-value	Remarks
Extent of Insect Pest Infestation	15.6	3	0.001	Significant
Extent of Disease Infestation	12.5	3	0.006	Significant
Extent of Weeds Infestation	4.17	3	0.244	Not Significant
Effect of the Pest on Harvest or Yield	12.8	3	0.005	Significant
Effect of Diseases on Yield	15.1	3	0.002	Significant

Psychological Factors and Pesticide Use

Perceptions and attitudes generally affect behavior (Borges, 2016; Ajzen, 1991). In this study, farmers' attitudes towards pests and their perceptions of their effects on the environment, food safety, and human health were examined. Likewise, their relationship to pesticide use was determined. Results of the test of independence between variables revealed that the two measures of farmers' attitudes towards pests were significantly related to their decision to use pesticides (Table 3). In particular, the statements "I will control or eradicate pests" and "Left uncontrolled, pests can cause extensive damage" significantly influenced their pest management decisions. These two statements are interrelated. The expressed behavioral intent to control or eradicate pests is connected to the second state's core substance, whereby the indirect effect of inaction is perceived to lead to extensive damage.

Similarly, the perceived increase in crop pest population was significantly associated with farmers' decision to use pesticides. Whether or not there was an emergence of new crop pests or that pests were getting

harder to control, did not matter to farmers' decision to use pesticides. It appears that the mere presence of an increasing population of pests was enough bases for farmers to use pesticides.

While the surveyed farmers held positive views about the importance, benefits of the right quality environment and the need to protect the environment, such was not significantly related to their decision whether or not to use pesticides on their crops. Supposedly, people who hold positive environmental views are less likely to use pesticides as a pest control strategy. The majority of the respondents were cognizant of the harmful effects of pesticide use regarding water, air, and soil contamination with pesticide residues (Table 3). One can surmise that farmers tend to put a heavier weight on the impact of pesticide use on crop yield and farm income than on the negative externalities related to its use. This is also evident in the absence of a relationship between the statement "pesticide use may contaminate water and soils" and farmers' decision to use pesticides.

Two other statements used to measure the farmer respondents' perception of the effects of pesticide use and pesticide exposure were not significantly related to the farmers' decisions to use pesticides on crop pests. Mainly, while farmers generally agreed with the statement, "Exposure to pesticides is hazardous to human health," such did not matter in their choice of a pest control strategy." This is evident in the widespread use of pesticides among the surveyed farmers. Similarly, there was no relationship between the statement "Pesticides may leave residues on vegetables making them unsafe to consume" and farmers' choice of pesticides for pest control, despite the widespread disagreement with the statement among the farmers.

Table 3

Test of Independence between Pesticide Use and Selected Psychological Factors

Psychosocial Factors:	Chi-Square	Df	P value	Remarks
Attitude Toward Pests				
I will control pest/eradicate pests	12.6	3	0.006	Significant
Left uncontrolled pest can cause extensive damage	6.99	1	0.008	Significant
I get worried when I see pests	2.71	2	0.258	Not Significant
Perceptions of Pests				
Pest populations are increasing	10.6	1	0.001	Significant

New Pests are emerging	1.45	1	0.228	Not Significant
Pests are getting harder to control	0.815	1	0.367	Not Significant
Attitude Towards the Environment				
Protecting the environment is essential to me	0.441	1	0.507	Not Significant
The right Quality environment is beneficial to all	0.145	1	0.703	Not Significant
Perceptions of the Effects of Pesticides				
Pesticide use in farms may contaminate water and soils	9.34	4	0.053	Not Significant
Exposure to pesticides is hazardous to human health	8.16	4	0.086	Not Significant
Pesticides may leave residues on vegetables	6.57	4	0.160	Not Significant

Extension-related Factors and Pesticide Use

The test for independence between extension-related factors and pesticide use revealed that membership in farmers' organizations is significantly related to adopting pesticides as a pest control strategy (Table 4). This corroborates what Oboh et al. (2008) pointed out that membership in cooperatives is a determining factor in farmers' adoption of new technologies. This is also closely related to Bonabana-Wabbi's (2002) findings, which indicated that membership, in farmers' association had positively affected the level of adoption of IPM technologies. Adeola et al. (2011) explained that farmers' organizations provide many opportunities for farmers' interaction with other farmers, which is an avenue through which agricultural innovations may diffuse among them. In two of the surveyed vegetable growing municipalities, all the sampled farmers were pesticide users. Hence, the possibility of farmers who are members of organizations to share farming-related experiences such as pesticide use is inevitable.

In contrast, attendance in training programs related to Integrated Pest Management was unrelated to pesticide use, suggesting that farmers' participation or nonparticipation in IPM training was not an influencing factor in their pest management decisions. Supposedly, farmers who have joined IPM training programs are less likely to employ pesticides against crop pests, as

was pointed out by Ferguson (1995). He indicated that farmers' participation in IPM activities affected the adoption of non-chemical methods and IPM technologies. Alternatively, farmers who have not attended training programs on IPM are supposed to lean towards the use of pesticides to control crop pests. IPM and the use of pesticides to control pests are grounded in contrasting philosophies regarding the crop pests' management. The former favors the use of a combination of pest control strategies in an integrated fashion with chemicals as the option of last resort. In contrast, the latter emphasizes an almost total dependence on chemical control methods against crop pests. The pervasiveness of pesticide users in the surveyed vegetable growing areas may have dulled the IPM training programs' impact.

The use of extension-related information sources and other communicative features are positively related to technology adoption, (Ofouko et al. 2008; Wu & Babcock, 1998; Barrera et al., 2005), corroborating the findings of this study. Information sources that were significantly associated with their decision to adopt the use of pesticides against crop pests were the pesticide dealers (p=0.00) and agricultural extension technicians (p=0.03). As a primary source of pesticide-related information, it is not surprising that farmers' decision to adopt the use of pesticides is significantly influenced by those who are actively involved in the promotion and actual sale of these products. A corollary to this, the frequency of contact between farmers and pesticide dealers was also significantly related to the farmers' use of pesticides against crop pests.

Table 4

Test of Independence between Pesticide Use and Selected Extension-Related Factors

Extension-related Factors	Chi-Square	df	P-value	Remarks
Membership in Farmers' Organization	4.96	1	0.045	Significant
Attendance in IPM Training	0.452 E-01	1	0.832	Not Significant
Information Source -Extension Technicians	4.51	1	0.034	Significant
Information Source –Pesticide Dealers	23.8	1	0.000	Significant
Frequency of Contact/talk with ATs	3.34	3	0.342	Not Significant
The frequency of Contact with Pesticide Dealers	22.2	3	0.000	Significant

CONCLUSIONS

Socio-economic factors such as gender, the number of farm parcels cultivated, and household income were significantly related to farmers' decision to use pesticides for pest control. Farmers who were males cultivated more land parcels and had higher household income tended to favor and implement a chemical-based pest control strategy.

The extent of insect pest and disease infestation on their crops significantly influenced farmers' decision to use pesticides against crop pests. Similarly, the effect of insect pests and plant diseases on crop yield led farmers to resort to a pesticide-based pest management strategy. These indicate that farmers were risk-averse, thus choosing a pest management strategy that was widely considered effective in reducing pest damage.

The farmers' regard of pests as extremely destructive and their expressed intent to control or eradicate them led them to use pesticides. Similarly, the perceived increase in crop pest population is significantly associated with farmers' decision to use pesticides. Whether or not there was an emergence of new crop pests or that pests were getting harder to control, did not matter to farmers' decision to use pesticides. It appears that the mere presence of an increasing population of pests was enough basis for farmers to use pesticides. This paper recommends that the Department of Agriculture should sustain, expand, and be more aggressive in promoting Integrated Pest Management (IPM) practices among vegetable farmers. Good IPM practices encourage using other non-chemical methods for pest control that do not endanger farmers' health, food safety, and environmental quality.

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REFERENCES

Adeola, S.S., Omolehin, R.A., Ahmed, B., & Adeniji, O.B. (2011). Socio-economic determinants of insecticides usage in cowpea production in Kaduna State, Nigeria. *J. Agric. Soc. Res. (JASR)*, 11. (1).

Ahmed, N., Englund, J.E., Ahman, I., Lieberg, M., & Johansson, E. (2011). Perception of pesticide use by farmers and neighbors in two peri-urban areas. *Sci. Tot. Env't,*. 412-41377-86.

Armah, F.A. (2011). Assessment of pesticide residues in vegetables at the farm gate: Cabbage (Brassica oleracea) cultivation in Cape Coast, Ghana. Res. *J. Environ. Toxicol,* 5,180-202.

Asadpur, H. (2011). Socio-economic factors affecting the development of biological technologies stem borer pest in rice fields of Mazandaran. *Agric. Econ. Dev't.,* 19(76), 231-252.

Ajzen, I. (1991). The theory of planned behavior. *Organ Behav Hum Decis Process,* 50(2),179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Baconguis, R.T. (2002). *Realities of alternative and conventional rice farming in M'lang, Cotabato, Philippines.* Ph. D. Dissertation (Unpubl.). University of the Philippines Los Banos, Laguna, Philippines.

Baral, K. , Roy, B.C., Rahim, K.M.B., Chatterjee, H., Mondal, P., Mondal, D., Ghosh, D., & Talekar, N.S. (2006). Socio-economic parameters of pesticide use and assessment of the impact of an IPM strategy for the control of eggplant fruit and shoot borer in West Bengal, India. Shanhua, Taiwan: AVRDC –The World Vegetable Center.

Barrera, V., Norton, G.W., Alwang, J.R., & Mauceri, M. (2005). Adoption of integrated pest management technologies: A case study of potato farmers in Carchi, Ecuador. *American Agricultural Economics Association Annual Meeting.* Retrieved from https://core.ac.uk/download/pdf/6779218.pdf

Bonabana-Wabbi, J. (2002). Assessing factors affecting adoption of agricultural technologies: The case of integrated pest management (IPM) in Kumi District, Eastern Uganda. (Master's thesis, Virginia Polytechnic Institute and State University). Retrieved from https://www.researchgate.net/profile/Anya_Mcguirk/publication/266217408_Assessing_Factors_Affecting_Adoption_of_Agricultural_Technologies_The_Case_of_Integrated_Pest_Management_IPM_in_Kumi_District_Eastern_Uganda/links/553facdf0cf2736761c0de6b.pdf..

Borges, J.A.R., & Lansink, A.O. (2016). Identifying psychological factors that determine cattle farmers' intention to use improved natural grassland. *Journal of Environmental Psychology, 45,* 89–96.

Davidson, D.J., & Freudenburg, W.R. (1996). Gender and environmental risk concerns: A review and analysis of available research. *Environ. Behav. 28,* 302-339.

Dinpanah, G., & Nezhadhosseinni, S.M. (2013). Factors influence the adoption of integrated pest management (IPM) by vine owner of Iran. *Int' l. J. Agron. Plt. Prods.,4*(10), 2514-2519.

Dosman, D.M., Adamowicz, W.I., & Hrudey, S.E. (2001). Socio-economic determinants of health and food safety-related risk perceptions. *Risk Anal. 21*, 307-317.

Dunlap, R.E., & Beus, C.E.(1992). Understanding public concerns about pesticides: An empirical examination. *J. Consum. Aff., 26,* 418-438.

Department of Pesticide Regulation (DPR). 2008. What are the potential health effects of pesticides? Community guide to recognizing and reporting pesticide problems. Retrieved from https://www.cdpr.ca.gov/docs/dept/comguide/effects_excerpt.pdf

Edwards-Jones, G. (2006). Modeling farmer decision making: Concepts, progress, and challenges. *An. Sci,. 82*, 783-790.

Ferguson, W., 1995. A logic model of cotton producer participation in professional scout programs. *J. Sust. Agric.,* 5(3).

Franzen, A., & Meyer, R. (2010). Environmental attitudes in cross-national perspective: A multilevel analysis of the ISSP 1993 and 2000. *Eur. Social. Rev., 26,* 219-34.

Hanson, S.O. (2007). *Gender issues in climate adaptation.* Stockholm, Sweden: FOI Swedish Defense Research Agency.

Lu, J.L. (2011). Insecticide residues in eggplant fruits, soil, and water in the largest eggplant-producing area in the Philippines. *Water Air Soil Pollut., 220*, 413-422.

Nieuwenhuijsen, M.J., Grey, C.N.B., & Golding, J. (2005). Exposure misclassification of household pesticides and risk perception and behavior. *The ALSPAC Group. Ann. Occup. Hyg., 49*, 703-709.

Oboh, V.U., Aye, G.C., & Hynde, A. (2008). Socio-economic determinants of farmers' adoption of improved cassava varieties in Oju Local Government Area of Benue State. In Proc. 20th Annual National Conference of Farm Management Association of Nigeria.

Ofouko, A.U., Egho, E.O., & Enujeke, E.C. (2008). Integrated pest management (IPM) adoption among farmers in central agro-ecological zone delta state, Nigeria. *Afric J. Agric. Res., 3*(12), 852-856.

Rahman, S. (2003). Farm-level pesticide use in Bangladesh: Determinants and awareness. *Agriculture, Ecosystem & Environment,95*(1), 241-252.

Rodrigues, D., Carvalho, T., Sousa, T., , Neto, V.S., Fechine, S., & Nascimento, R. (2011). Determination of insecticide residues in vegetal fruits. *Chromatography Research International* https://doi.org/10.4061/2011/713256

Rogers, A., Taylor, P., Lindsey, W.A., Crowder, L.V., & Soddemann, M. (1998). *Participatory curriculum development in agricultural education: A training guide.* Rome, Italy: Food and Agriculture Organization of the United Nations.

Rola, A.C., Chupungco, A.R., Roquia, F.H. Jr., Tejada, A.W., & Hernandez, J.T. (1999). *Philippine crop protection policy: Implications for food safety and farm profitability in vegetable sector.* University of the Philippines Los Baños (UPLB: Institute of Strategic Planning and Policy Studies, College of Public Affairs.).

Tassell van, L.W., Ferrell, M.A., Yang, B., Legg, D.E., & Lloyd, J.E. (1999). Pesticide practices and perceptions of Wyoming farmers and ranchers. *J. Soil Water Conserv. 54*, 404-410.

Wu, J., & Babcock, B.A. (1998). The choice of tillage, rotation, and soil testing practices. *Amer. J. Agric. Econ., 80*, 894-511.